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BLOW MOLDED PALLET WITH WAVE-LIKE SUPPORTS

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BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates in general to the field of plastics. More particularly, the present invention relates to a pallet system and a pallet apparatus and a method of pallet manufacturing. Specifically, one preferred embodiment of the present invention relates to blow molding a first pallet section or portion with a wave-like support and then inserting it into another mold to join it to a second blow molded pallet section or portion with a wave-like support.

2. Discussion of the Related Art

Pallets are used for transporting and storing various types of cargo throughout the world. Therefore, it is important for a pallet to be lightweight, compact and strong. Traditionally pallets were made of wood, however, plastic pallets are now being used with increased frequency as they are lightweight, generally stronger, do not absorb moisture, and they can be cleaned and disinfected which is important in particular for the food industry. One disadvantage of plastic pallets is that they tend to break up with continued use over time. Therefore, for these and other various reasons it is important that plastic pallets be reinforced by a variety of means.

The below-referenced U.S. patents disclose embodiments that were at least in part satisfactory for the purposes for which they were intended. The disclosures of all the below-referenced prior United States patents, in their entireties, are hereby expressly incorporated by reference into the present application for purposes including, but not limited to, indicating the background of the present invention and illustrating the state of the art.

U.S. Patent No. 5,417,167 discloses a plastic shipping pallet of the type usually manufactured from wood which is made of hollow plastic stringers and deck boards. The stringers and deck boards are made of plastic materials that may be either virgin plastic, recycled plastics or mixes. The stringers and deck boards are hollow but have closed ends to prevent entry of dirt, fluids, insects and vermin. The stringers and deck boards may be made in a blow molding process or using continuous extrusion and molding processes similar to that used in the manufacture of corrugated pipe. Various connection configurations for affixing the deck boards to the stringers are described including fixation by screws as well as

interlocking connections between the plastic parts themselves and the use of separate interlocking components which engage the deck board and stringers.

U.S. Patent No. 5,845,588 discloses a pallet fabricated of a thermoplastic material which is produced by joining together individually fabricated structural components, each of which is individually thermoformed from an extruded plastic parison of a multilayer structure. The structural components include a deck in the form of a continuous sheet with longitudinal and transverse sides, one or more upper runner components fastened by their top side to the bottom of the deck, each of which includes a cross member with downward-facing posts, and one or more lower runner components, each of which includes a cross member with upward-facing posts and which is fastened by the tops of its posts to the bottoms of matching posts on the corresponding upper runner components.

U.S. Patent No. 5,868, 080 discloses a reinforced plastic pallet construction and assembly method are presented wherein multiple reinforcing bars are employed. At least some of the reinforcing bars have an exposed surface at a topside surface, underneath surface or underside surface of the pallet. In addition to functioning as a reinforcing member, the exposed surfaces of the reinforcing bars comprise an anti-skid surface for maintaining positioning of payload on the pallet or facilitating transport of the pallet, e.g., via a forklift or automated transport system. Various techniques for retaining the reinforcing bars within channels formed in the plastic pallet body are described. The reinforcing bars preferably comprise composite structural members of fiberglass-reinforced plastic fabricated from a pultrusion process.

U.S. Patent No. 6,209,464 discloses a pallet that includes a rectangular support deck having a substantially planar upper supporting surface including a plurality of channels formed therein and extending across the pallet. The deck includes support members extending from an underside of the deck that nest in recesses formed in the upper surface of the deck. An alignment portion is formed at a center point along the first edge of the deck and a second alignment portion is formed at a center point of an opposed edge of the deck. The alignment portion includes angled sides for receiving a tapered member of a complementary device.

SUMMARY AND OBJECTS OF THE INVENTION

It is one object of the present invention to provide a pallet system that is relatively inexpensive to manufacture, recyclable, and environmentally friendly.

It is another object, to provide a pallet design that is structurally strong, yet relatively lightweight, and generally easy to manufacture.

In accordance with one aspect of the invention, the inventive pallet system has a first portion and a second portion having interiors that fit together to provide strength and stability to a preferably blow molded pallet body.

These and other aspects and objects of the present invention will be better appreciated and understood when considered in conjunction with the following description and the accompanying drawings. It should be understood, however, that the following description, while indicating preferred embodiments of the present invention, is given by way of illustration and not of limitation. Many changes and modifications may be made within the scope of the present invention without departing from the spirit thereof, and the invention includes all such modifications.

BRIEF DESCRIPTION OF THE DRAWINGS

A clear conception of the advantages and features constituting the present invention, and of the construction and operation of typical mechanisms provided with the present invention, will become more readily apparent by referring to the exemplary, and therefore non-limiting, embodiments illustrated in the drawings accompanying and forming a part of this specification, wherein like reference numerals designate the same elements in the several views, and in which:

Fig. 1 shows a top perspective view of one embodiment of the pallet of the present invention;

Fig. 1A shows a cross-sectional view along line A-A in Fig. 1;

Fig. 1B shows a cross-sectional view along line B-B of Fig. 1;

Fig. 1C shows a cross-sectional view along line C-C of Fig. 1;

Fig. 1D shows a cross-sectional view along line D-D of Fig. 1;

Fig. 1E shows a cross-sectional view along line E-E of Fig. 1;

Fig. 2 shows a bottom-perspective view of the pallet of Fig. 1;

Fig. 3 shows an exploded top-perspective view of the pallet of Fig. 1;

Fig. 4 shows an exploded bottom-perspective view of the pallet of Fig. 1;

Fig. 5 shows an exploded front view of the pallet of Fig. 1;

Fig. 6 shows mold form halves used to form the pallet of Fig. 1;

Fig. 7 is a top-perspective view of another embodiment of the present invention;

Fig. 8 is a bottom-perspective view of the pallet of Fig. 7;

Fig. 9 is a front view of the pallet of Fig. 7;

Fig. 10 is a side view of the pallet of Fig. 7;

Fig. 11 is an exploded top-perspective view of the pallet of Fig. 7;

Fig. 12 is an exploded bottom perspective view of the pallet of Fig. 7;

Fig. 13 is an exploded top-perspective view of yet still another embodiment of the pallet of the present invention;

Fig. 14 is an exploded bottom-perspective view of the pallet of Fig. 13;

Fig. 15 is an exploded front view of the pallet of Fig. 13;

Fig. 16 is a side view of the pallet of Fig. 13; and

Fig. 17 is an exploded top-perspective view of yet still another embodiment of the pallet of the present invention;

Fig. 18 is an exploded bottom-perspective view of the pallet of Fig. 17;

Fig. 19 is sectional schematic with a magnified view of the pallet of Fig.17;

Fig. 20 is a side view of another embodiment of the present invention; and

Fig. 21 is an a schematic illustrating the method of the present invention.

In describing the preferred embodiment of the invention, which is illustrated in the drawings, specific terminology will be resorted to for the sake of clarity. However, it is not intended that the invention be limited to the specific terms so selected and it is to be understood that each specific term includes all technical equivalents which operate in a similar manner to accomplish a similar purpose. For example, the word "connected" or terms similar thereto are often used. They are not limited to direct connection but include connection through other elements where such connection is recognized as being equivalent by those skilled in the art.

DETAILED DESCRIPTION

The present invention and the various features and advantageous details thereof are explained more fully with reference to the non-limiting embodiments described in detail in the following description.

1. Resume

As shown in the embodiment of Fig. 1, the present invention comprises a pallet system that has a body including a first portion and a second portion. The first portion is preferably the top portion and the second portion is preferably the bottom portion. The first portion has a generally planar outer surface and an inner surface at least a portion of which is distant the outer surface. The inner surface of the first portion is non-planar. In one preferred embodiment adjacent one set of outer edges, the inner surface has a pair of generally U-shaped feet that extend from one edge of the pallet to an opposing edge. Preferably, at the bottom of each foot is a rib that extends the length of the foot. Inside each foot and parallel to it is a channel. Between the channels and parallel to them is a middle support having generally the same width as each channel. The middle support extends away from the outer surface a distance less than the distance that the feet extend away from the outer surface.

The channels and middle support has a succession of curves having spaced apart ridges that define grooves.

The second portion has an outer surface and an inner surface at least a portion of which is distant the outer surface. The inner surfaces of the first and second portions each have complementary undulating forms. The inner surfaces of the first and second portions each include a succession of curves.

The outer surface of the second portion includes at least a pair of channels that extend from one edge to an opposing edge. The pair of channels is dimensioned and configured to receive tines of a forklift. On each outer side of the tine-accepting channels is a leg with at least one foot that extends parallel to the channels from one edge to an opposing edge and that rests on a surface. In a preferred embodiment, the feet run the longitudinal length of the pallet. In between the pair of channels is a support that extends parallel to the channels and preferably spans longitudinal length of the pallet.

The inner surfaces of the first and second portions each includes a succession of curves having rises and falls that run perpendicular to the series of ridges and grooves on the outer surface of the second portion.

The inner surface of the first portion is molded to the inner surface of the second portion.

The outer surface of the second portion comprises a series of ridges and grooves.

The outer surface of the first portion is generally planar such that, e.g., boxes can be stacked upon it.

The inner surface of the first portion is connected to the inner surface of the second portion. The inner surface of the first portion and the inner surface of the second portion comprise complementarily shaped surfaces.

2. Preferred Embodiments

With reference now to the drawing figures in which like reference numerals designate like parts throughout the disclosure, Fig. 1 shows a pallet system 5 of the present invention. As best shown in Figs. 1A–Fig. 4, the pallet system 5 consists of a pallet body 10 having a first or upper portion 12 with a first outer surface 14 and a first inner surface 16 (see Fig. 4). The pallet body also has a second or bottom portion 20 having a second outer surface 22 and a second inner surface 24 (see, e.g., Figs. 2 and 3). A first distant portion 18 is also contained in the first portion 12 and a second distant portion 26 is contained in the second portion 20 (see Fig. 1A). The first portion 12 preferably has a first set of protrusions 30 which connect to the second portion 20. In one preferred embodiment, protrusions 30 interdigitate between a second set of protrusions 32 located on the second portion 20 (see Fig. 3).

As best shown in Fig. 4, a first leg 38 and a second leg 39 may also be provided on the pallet body 10. In other embodiments, these legs actually may be made up of one or more feet (40, 41, 42, 43, 44, and 45) as shown in Figs. 7 through 12. As shown in yet another embodiment (Figs. 13–15), the legs 38, 39 are preferably formed from an extension 51 on the first portion 12 which is received by a channel 46 on the second portion 20 as best shown in Fig. 15.

In one embodiment, one significant feature is that a plurality of corrugations 56a, 58a from the first portion 12 preferably interconnect with a plurality of corrugations 56b, 58b

from the second portion 20. The corrugations may be made up of a combination of both humps 56 and valleys 58 in combination with ridges 52 and grooves 48 (see, e.g., Figs. 4, 12 and 14). The ridges, humps, valleys and grooves may have various shapes and sizes. When the corrugations are mated together, the upper corrugations 56a, 58a may have extending members 76 in the middle between the tine holes which fit into cavities 78 in the tine holes on the lower corrugations 56b, 58b (see Fig. 14).

The corrugations may run along the X direction and/or the Y direction. Preferably, the Y direction is 48 inches and the X direction is 40 inches.

As shown in Fig. 15, one preferred embodiment also has apertures 80 which receive ribs or locking members 82. Escape holes 84 may also be formed in the first portion 12 and the second portion 20 by mold form pins (not shown) to allow the injected gases which are inserted in the blow molding process to properly escape. When the extending members 76 and the cavity 78 come together while the blow molded plastic portions are still hot, they may form a tack-off point 90 (see Figs. 1, 7, 9).

As shown in Fig. 13, the embodiment may have inserts 94 which are formed from a more rubberized plastic (e.g., EVA). This material also has greater friction to prevent loads from slipping off an otherwise slick polyethylene top surface. Alternatively, a coating 96 may be applied as shown in Fig. 11 where it is shown applied to one half of the first outer surface 14.

In one embodiment, best shown in Fig. 16, the body 10 of the pallet system is "bowed" at an angle α from the horizontal plane. Angle α is preferably 6° of less.

2. Manufacture

The preferred embodiment is preferably manufactured in several ways.

Fig. 17 shows a general process flow diagram illustrating the method used to construct the pallet of the present invention. The process begins preferably with the first forming of the bottom portion in a conventional blow molding form having two halves. The cycle times and molding characteristics are adjusted to the materials being molded. When inserts are required they may be molded in a separate injection molding process. The bottom portion is formed to mate with the mold form used to blow mold the top portion. Additional chemical bonding or bond-promoting agents may be used or some roughening of the surface may also be used to enhance bonding. A gap or air port may be provided between these

pieces so that air can be released during the bonding of the two portions together. Such a gap normally occurs around the midline or pinch-off area where the mold halves meet.

Fig. 6 depicts one pair of symmetrical extrusion mold forms which are used to form a pallet portion. Water-cooling channels within the mold form (not shown), parison pinch-offs (not shown) and air/gas access ports or needles (not shown) are provided in conventional fashion within the mold form to effect proper molding. It may be necessary to provide grooves, clamps, or other retaining mechanisms within the mold to provide retention of the lower piece into the mold form for the upper piece.

First, various types of plastic (e.g., virgin and recycle) are added to a hopper. The hopper feeds an extruder where the plastic is heated. Parison of molten plastic (e.g., a polyethylene material) is next extruded and vertically suspended between mold halves. Typically, the material is heated to a molten state and the temperature is in a range from 350° to 450°F. Once the material is introduced into the mold form, the parison is pinched off as the mold closes. After the mold closed about the parison and an air or gas is injected via one or more injection needles into the parison, the air is directed such that the material is blown onto the contoured wall surfaces of the mold forms.

The pallet portions may be made out of a variety of materials such as linear low polyethylene (LLPE), high-density polyethylene (HDPE), and/or may include some natural rubber. For example, a mixture of 20% to 30% polyethylene and a natural rubber product called Duraprene may be used. This allows for a flexible yet strong pallet which can properly carry up to three thousand pounds. One preferred material will meet the following ASTM standards: D297, D412, Die C, D624, Die C, F36, D2240, F147, D471, as well as ASTM #1, #3, and Fuel A and Fuel C. Duraprene can be obtained through a company called Lamatek (see http://www.lamatek.com).

Next, the bottom portion is placed into a mold form to make an upper portion. Retaining pins or clamps may hold the bottom portion in the mold form. Parison is again extruded between the mold form halves and the above process begins again. The blown polyethylene material thereby retains the bottom portion against the mold walls. During this insert molding process, other already formed pieces (such as rings to add surface friction) may also be inserted into the blow mold form (having two halves) where they are retained during the blow-molding process and integrally bonded into one of the newly formed blow-

molded surfaces. Relative temperatures of the inserted pieces and/or bottom portion and the material are such that the hot material coats and melts the inner surface of the pieces and/or the portion to coalesce and form integral bond with one another. Depending on the materials, the mold forms may also preheat and soften the pieces and/or portions. For the pieces, an EEA material may be used while polyethylene may be used for the portions.

The EEA material used has a melt temperature typically in the range of 250° to 300°F and the preferred polyethylene material typically has a melt temperature in the range of 375° to 450°F. Other relative temperature ranges could be used, provided the materials will flow melt bond to one another. It is important that the dwell time of each mold piece is properly set to prevent the formation of air pockets at the bonding surface which can prevent proper lamination.

Further increasing the cooling time may be necessary to prevent any sinking or shrinking of the bonding surface. Again, which could produce unwanted delamination. Alternatively, reducing the dwell time helps to release air which becomes trapped at the bonding surface during molding. Typical cycle times of 1x to 2x at air gas pressures of 80 to 150 psi and dwell times of 1y to 1.5y, where y and x are comparable values for noncomposite pieces of identical design.

While the pallet body 10 is preferably formed from two blow molded portions, it is possible the portions may be formed by injection molding, thermo-forming, or another plastic molding process.

The depths of any grooves or projections (e.g., Fig. 15 references 80, 82) which are used to enhance bonding can be adjusted to take into account shrinking and/or melting that occurs at the bonding of the surface. The projections may comprise annular or lateral ribs or studs or combinations thereof. Dovetail projections or studs with heads may also be used. Some projections may serve to retain a tread piece while others create an air channel and melt away.

As shown in Figs. 13–16, the upper portion 12 may be made of a first plastic mixture and the bottom portion 20 may be made of a second plastic mixture. Such mixtures may give the give the portion different anti-slippage or weight-bearing properties. For example, the upper portion material (e.g., EEA and real rubber) may be stiffer while the bottom portion material may have greater impact strength.

The pre-formed insert pieces 94 are preferably constructed from a low density, relatively soft polyethylene material of the polyolefin family. The material particularly comprises an ethylene-ethyl acrylate (EEA). This material doesn't readily bond to polyethylene using traditional adhesion methods, such as RF sealing, ultrasonic bonding or spin welding. EEA, however, is commercially available in a number of compositions which accommodate a variety of operating temperatures or melt ranges below that of the materials used to blow mold the pallet 5. Two 18% EEA compositions having respective 20 and 6 melt ranges have been shown to be desirable. The lower temperature (i.e. 20 melt) material is softer and more readily assures proper bonding, but is less scuff resistant.

Alternative pre-formed insert materials may comprise ethyl-vinyl acetate (EVA), low-density polyethylene (LDPE) or linear, low-density polyethylene (LLDPE). Variations of the foregoing materials may also be blended, as necessary, to provide desirable mechanical properties for a particular application.

An EEA pre-formed insert material is presently preferred for the pallet 5 because it is relatively durable and readily bonds under flow melt conditions to the polyethylene upper portion. The EEA material is also less dense than many materials, in particular, the polyethylene materials used to typically mold the pallet. The pre-formed insert 94 thus exhibits a softer texture than the pallet top portion 12, which produces improved traction between the pallet and the load. Depending upon the application, it may however be desirable to use a harder pre-formed insert material, similar to that of the pallet top portion 12.

In the embodiments shown in Figs. 17-20, pallet 99 has a body 100. The runners 101 attached to the body 100 that are preferably designed with a slight radius 102, 103 on the outside edges 104, 105 to add strength and durability and to prevent the pallet 99 from getting hung up on expansion joints in a warehouse floor or a conveyor and also to prevent breakage of fragile corners or edges. In this embodiment, all of the pallet body's edges (e.g., 125) have radiused corners (see e.g, 106, 108, 110, 112, 114, and 116).

This pallet 99 may also have three components 118, 120, and 122 (a top, middle and bottom section respectively as shown in Figs 17-19) or two components (e.g., a top and bottom section as shown in Fig. 20) depending on the application. For example, the three-portion pallet would be used for more heavy-duty applications while the two-portion pallet

may be used for medium-duty applications. The same molds may be used to make the top sections and bottom sections of the three portion and two portion pallets. However, as can be seen, a middle section mold is only likely to be used by the three-portion heavy-duty pallet.

When the portions are insert molded, the portion weld points or tack or kiss-offs 126 are preferably found at both the peaks 130 and the valleys 132 of the inner surfaces 140, 141, 142, 143 where the portions 118, 120, and 122 meet as shown in Fig. 18. This feature gives added structural strength and stability to the pallet 99. Fig. 19 illustrates that this embodiment of the blow-molded pallet 99 has a .5 inch lip 150 around the center edge 160. The lip 150 allows for easier handling by pallet transfer equipment and provides an anchor point for plastic shrink-wrap and/or tie down straps.

In the preferred embodiment shown in Figs. 17-19, the runners are preferably about 4.75 inches high and about 6.5 inches wide. The peaks extend to a height of about .75 inches from the inner surface and are about 1 inch wide. The pallet from top surface to bottom surface is approximately 5.75 inches high. The length of the pallet may 40 inches and the width may be 48 inches.

The runners or legs 101 are preferably formulated from a puncture resistant HDPE plastic resin. These HDPE plastics may be acquired from FORMOSA PLASTICS CORPORATION USA (see www.fpcusa.com) and may, for example, include hexane copolymers, homopolymers, extra high molecular weight copolymers having densities between about .945 -.955 g/cc and melt indexes about .30 – 10.0(HLMI) g/10 min. Alternatively, puncture resistant properties may be added by blending in plastics with these characteristics into the typical polyethylene material. Puncture resistance of the plastic is desirable in some applications because some pallets are frequently moved by forklifts bearing sharp tines or forks.

Of course, one of ordinary skilled may see other possible changes to the pallet designs for example with the corrugations running in the 40-inch direction. In the some of the above described embodiments, the corrugations in the bottom portion of the pallet stop at the inside face of the runners, with the top surface (of the bottom portion) dropping into the runners. However, another design change (see, e.g., Figs 17-19) involves running the corrugations to the outside of the runners, except at each end of the runners where the top surface will continue to drop into the runner. This change will help to stiffen the runners

(rotationally), but still provide an extra layer at the ends of the runners that see impact from forks.

Adding additional structural rigidity may be accomplished by adding an aluminum or steel insert, running the length of the runners, in, for example, the four-way pallet design.

The individual components described herein need not necessarily be formed in the disclosed shapes, or assembled in the disclosed configuration, but could be provided in virtually any shape, and assembled in virtually any configuration. Furthermore, all the disclosed features of each disclosed embodiment can be combined with, or substituted for, the disclosed features of every other disclosed embodiment except where such features are mutually exclusive. Finally, it is intended that the appended claims cover all such additions, modifications and rearrangements. Expedient embodiments of the present invention are differentiated by the appended subclaims.